Sequential Multiwell Sedimentary Facies Prediction in the Nu'ayyim Formation, Saudi Arabia

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ABSTRACT

The objective of this study is to improve the accuracy of sedimentary facies prediction in the Nu'ayyim Formation by introducing a new facies prediction workflow consisting of the sequential integration of core data, borehole image, and openhole logs. Unlike lithology-based lithofacies prediction, rock texture and structural-based sedimentary facies prediction is more challenging because of the variation of openhole log responses and limited cores. In many cases, borehole images can provide clear rock texture and structure information like slabbed cores. The image logs can be directly used for certain sedimentary facies interpretation in the Nu'ayyim Formation, such as eolian dune and interdune facies. Borehole image logs can fill the gaps between uncored intervals, as well as providing additional textural and structural information for uncored wells. Consequently, the utilization of the borehole image logs is crucial to improve the accuracy of multiwell sedimentary facies prediction. Conventionally, core facies are the only input data to guide the openhole logs for the multiwell facies prediction through supervised neural network techniques. This study provides a new facies perdition workflow that includes three sequential steps. First, running core-guided neural network facies predication for imaged wells. Second, adjusting facies prediction according to the image texture, dip patterns, and openhole log motifs. Finally, repeating the facies prediction process for all the wells in the study area, with the guidance of core and image logs facies together. This sequential sedimentary facies predication workflow optimizes the application of image logs during the facies prediction process. Consequently, this increases the accuracy of the facies prediction. Through the integration of 18 wells, seven of which have image logs, eight have core data, and three have both image and core data, the new sequential facies prediction workflow derives better sedimentary facies prediction results. This is in terms of facies prediction accuracy that has increased by more than 5% for the cored blind test well. As a result, an improved facies predication accuracy for the remainder of uncored wells is expected.